1884MNRAS..45...37.

Occultations of Stars observed at Dun Echt during the Total Lunar Eclipse of October 4, 1884.

(*Communicated by Lord Crawford.*)

1. Observations with the Grubb Equatorial of 15·06-ins. aperture, power 122; observer, Ralph Copeland.

No. in the Pulkowa List.	Magnitude.	Phenomenon.		Observed Time by Chronometer.	Dun Echt Mean Time.
				h m s	h m s
94	9–10	Disappearance		10 16 24·5	10 6 41·8
				by Chronograph	
95	9·5	Disappearance		23 5 46·8	10 10 45·3
82	10	Reappearance*		23 9 50·7	10 14 48·5
85	10	,,		23 22 9·5	10 27 5·3
81	9·5	,,		23 22 59·7	10 27 55·4
109	8·8	Disappearance		23 25 56·4	10 30 51·6
108	9–10	,,	†	23 25 57·2 – 0$^{\rm s}$·5	10 30 51·9
107	10	,,	‡	23 28 23·4	10 33 18·2

The chronometer corr. at 7$^{\rm h}$·9760 by chronom. = –9$^{\rm m}$ 41$^{\rm s}$·73 – 0$^{\rm s}$·4158 per hr.

The chronograph corr. at 22$^{\rm h}$ 35$^{\rm m}$·3 by chronog. = + 59·34 + 0·0822 ,,

State of Weather and General Remarks.

Although there were only a few cumulus clouds scattered over the heavens, and the sky in general was fairly clear, the illuminated haze around the Moon was too bright to permit of stars 57, 62, 69, and 71 of the Pulkowa list being seen at all, even in the 15-in. telescope. No. 74, of the 9·3 magnitude, was, in fact, the first star made out, and that only with extreme difficulty, shortly before its disappearance, which took place

Notes.

* 82 reappeared suddenly.

† (108) Signal given half a second too late; the disappearance followed so closely on that of 109, that the key could not be pressed early enough for the second record.

‡ (107) The Moon's limb was of a bright primrose colour, and the star appeared to cling to the edge for several seconds before disappearing.

By the time (10$^{\rm h}$ 16$^{\rm m}$·6 G.M.T) when 94 ought to have reappeared, the sky had become quite white through illumination by the uneclipsed part of the Moon, and the limb was not visible for more than 3′, or at most 4′ from the northern cusp. The 9$^{\rm m}$ star, 106*a*, the place of which is given below, was seen at 11$^{\rm h}$ 21$^{\rm m}$ G.M.T., about two minutes after egress, and its reappearance might have been observed if attention could have been directed to the *exact* place of emergence. On the other hand, the 8$^{\rm m}$·8 star 109, which was predicted to reappear at 11$^{\rm h}$ 49$^{\rm m}$ 50$^{\rm s}$ G.M.T., although caught sight of about 30$^{\rm s}$ later, was then so very faint that its egress could not have been observed with more certainty than that of a comparatively small star at the Moon's bright limb under ordinary conditions. Its 9–10 mag. companion, 108, was indistinguishable in the glare, and within about another minute the star itself had disappeared in the increasing light of the emerging Moon.

1884MNRAS..45...37.

about $9^h\ 3^m\ 52^s$ G.M.T., or 15^s later than predicted; but the observation is altogether too uncertain to be of any use beyond showing that the star was actually seen. After this for a time the clouds were very troublesome, the only record being to the effect that a momentary glimpse of the Moon's eclipsed limb was obtained at $9^h\ 17^m$. About 10^h G.M.T. a sudden change for the better took place, and at $10^h\ 1^m\ 45^s$ the group of stars 69, 71, 74, 76, and 76*a*,* the last certainly not brighter than the 11th magnitude, and not in the Pulkowa list, were beautifully seen in a splendid black sky through a momentary rift in the clouds, the star 74 which had just emerged being only some 30″ from the Moon's limb. Unfortunately there were no occultations for the next quarter of an hour, but those that came subsequently were observed with great certainty until about $10^h\ 43^m$ G.M.T., when the rapid brightening of the Moon as it approached the margin of the shadow began again to cast difficulties in the way. By 10 or 12 minutes after the end of the total phase, or by 11^h G.M.T., the special facilities of the occasion may be said, in a great measure, to have passed away, although from what was seen of stars 106*a* and 109 it seems that the egresses of 8 or 8½ magnitude stars might have been observed at the Moon's obscured limb until the end of the actual *umbral* eclipse, and conversely the disappearances of such stars might have been perceptible at the commencement of that phase. The record at $10^h\ 2^m$ shows that near the middle of a total lunar eclipse stars of the 11th magnitude may be advantageously placed on an occultation list.

When the Moon was visible the corresponding places of the stars on her limb were readily found by simply setting the telescope in declination, which can be quickly done from the eye-end of the instrument. At other times use had to be made of the configurations of neighbouring stars, as shown in the map.

2. Observations made with the 6·06-in. Simms' Equatorial, power 91, by Mr. J. G. Lohse.

As a preparation the 16 stars for which the predicted times of disappearance and reappearance had been sent from Pulkowa by M. Struve were mapped on a large scale on millimetre paper, together with the apparent path of the Moon, the necessary data having also been supplied from Russia. A comparison with Chacornac's map made it probable that two additional stars might be occulted, so on the next clear night these, as well as a few other stars that were to serve as guides for the reappearances, were connected micrometrically with the nearest star of the Pulkowa list. The phenomena were numbered 1 to 36, and the order in which the stars disappeared and reappeared indi-

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* (76*a*) $\alpha = 11^\circ\ 12'\cdot 5$, $\delta = +3^\circ\ 51'\cdot 8$.

1884MNRAS..45...37.

cated on the map by writing the number of the disappearance below and that of the reappearance above each star. No use was made of the position angles for the reappearances, for it was to be expected that the Moon's light would not be sufficient to make the wires visible, and a constant artificial illumination would have been very objectionable. The known differences of declination between the stars, however, made it very easy by a series of simple operations to bring the spot where the reappearance was to be looked for into the centre of the field. Having selected for every star a conveniently situated reference star, and ascertained beforehand the readings of the micrometer screws corresponding to the difference of declination of these two stars, it remained to set the micrometer, illuminate the wires, bring the reference star on to its wire by the slow motion in declination, centre the other wire by means of the slipping-piece, remove the illumination, and turn the telescope by the slow motion in Right Ascension, until the edge of the Moon was in the centre of the field. Should the Moon not have been visible, the map would have permitted an estimate of the distance from the reference star.

Before the total phase the Moon was several times well seen between clouds, but not a trace of the stars could be made out. Gradually the clouds thickened, and hid the Moon for the first half of the total phase. The sky then began to clear up and eventually became perfectly cloudless.

During the totality the moon was very faint, and the copper tint, so conspicuous in other eclipses, was only seen occasionally, and then only feebly, and not uniformly spread over the Moon, but more intense in some parts than in others.

The following are the observations obtained during the latter half of the totality. The times were chronographed, as were also the observations for time. The places of the fundamental stars were taken from the *Berliner Jahrbuch.* Of the signals, three were noted as having been sent too late by about one second, the corresponding times have therefore been lessened by that quantity.

No. in the Pulkowa List.	Magnitude.	Phenomenon.	Observed Time by Chronograph.				Dun Echt Mean Time.		
			h	m	s	s	h	m	s
94	9–10	Disappearance	23	1	44·2	± 1	10	6	43·4
95	9·5	,,		5	48·75	– 1		10	46·2
82	10	Reappearance		9	50·0			14	47·8
—	—	,,		[10	10·1	– 1]			
85	10	,,		22	18·0	– 1		27	12·8
81	9·5	,,		22	59·35			27	55·0
109	8·8	Disappearance		25	56·55			30	51·8
Anon.	9	,,		26	32·7			31	27·8

1884MNRAS..45...37.

The corrections for the chronograph are the same as before.

Notes.

(94) Very difficult; uncertain to about $\pm 1^s$.

(95) Very difficult; about 1^s late.

(82) This star reappeared suddenly, and was duly chronographed at $23^h\ 9^m\ 50^s{\cdot}0$, but it was hidden so quickly afterwards by clouds, as to leave a doubt of its having been seen. On its again becoming visible 20^s later, a second signal was given. There seems little doubt that the earlier record marks the actual reappearance.

(85) Observation fairly good, but sent the signal 1^s too late.

(81) Fairly good.

(109) Good. No. 108 was too faint to attempt an accurate observation; it disappeared almost immediately after 109.

Anon. (106*a*). Observation good. The approximate place from a single observation is

$$\alpha = 11^\circ\ 49'{\cdot}8, \quad \delta = +4^\circ\ 7'{\cdot}6.$$

No. 107 was missed, and at the time of the disappearance of 106 the field of view was so strongly lit up by the partly illuminated Moon, that neither this star nor any of the others that had already reappeared could be seen.

Lord Crawford's Observatory,
Dun Echt:
1884, *Nov.* 13.

Total Eclipse of Moon, Oct. 4, 1884. By the Rev. S. J. Perry, F.R.S.

This eclipse was observed at Stonyhurst under very favourable circumstances, although the heavy dew interfered occasionally with the definition of the telescopes.

With a good binocular the Moon's disk was easily seen throughout the whole of totality, but to the naked eye there was no outline, the Moon having the appearance of a bright patch of light. The usual copper tint of the eclipsed Moon was not perceived except towards the close of the eclipse, and then it was only very slight. The general appearance in the binocular was that of a dull white ball, rather more brilliant at one part of the surface than elsewhere. The telescopes used were two Equatorials of 8 and 4 inches, a 9½-inch Cassegrain, and a 7-inch Newtonian. The nature of the phenomena does not appear to admit of any great accuracy in the contacts.